Quality Assurance and Quality Control Policy for Waterworks: An Overview for Smaller Waterworks

This overview and the associate model policy is intended to aid communities and waterworks owners and operators develop a Waterworks Quality Assurance and Quality Control (QA/QC) Policy. This overview is aimed at smaller waterworks, those serving less than 4,000 to 5,000 people, although larger centres may also find it useful. Saskatchewan Environment (SE) also has further details for larger operations in the form of "Guidelines for Quality Assurance and Quality Control for Water Utilities, EPB-242".

In simple terms, a QA/QC policy is a written statement of intent to provide safe drinking water, typically water that meets all the quality and production related requirements of *The Water Regulations, 2002*. Beyond a statement of intent, a QA/QC policy for smaller waterworks will contain documentation on:

- the organizational structure of the waterworks staff and management (who does what and their roles);
- the requirements for the routine day to day operation and maintenance of the waterworks (an operational and maintenance plan or protocol outlining operations and maintenance of the water plant and distribution system);
- water quality monitoring, data collection, record keeping, record review and reporting procedures (how records are to be kept and by who, for how long, etc); and
- plans for action in the event of an emergency or upset at the waterworks or incident which affects the raw water supply (an Emergency Response Plan).

Quality Control steps need to be built into the policy as "double checks" to find, control and resolve errors with the operation, maintenance and record keeping/review so that if mistakes are made, steps are taken to make sure they are corrected and prevented in the future. Additional value can be built into the QA portion of the policy if information on watershed protection, the financial sustainability of the system and plans or direction for continuous improvement is also provided. Since all waterworks differ, owners and operators will need to adapt and supplement the model policy to fit the specific site and situation.

Adoption of a QA/QC Policy and the associated measures will provide a high level of assurance /confidence to the consumers, staff and regulators that systems and procedures are in place to produce safe and high quality drinking water.

The need for a QA/QC Policy in Saskatchewan is based on the North Battleford Commission of Inquiry, Recommendation #3: "each permit to operate a surface water treatment plant should require as a condition to operate that there exist a quality control/quality assurance written policy in place that is acceptable to the regulator". In response, the Government of Saskatchewan introduced a regulatory requirement for all waterworks regulated by SE to have in place a QA/QC policy by December 31, 2003.

EPB 243 1200/03

Saskatchewan Environment
Environmental Protection Branch

Waterworks Quality Assurance/Quality Control Policy

For The Community Of _____

Approved: _____ **Date:** _____

1. Policy Statement

We, "the name of the owner / operator of the drinking water system servicing _____ " understand that supplying good quality drinking water is essential to the continued growth, prosperity, and well being of our citizens. We are committed to managing all aspects of our water system effectively to provide safe and aesthetically appealing water that tastes good and is free from objectionable colour or odour. It is our policy that the drinking water we provide will be produced in accordance with and meet or exceeds the quality standards required by *The Water Regulations, 2002.*

To achieve our goals we will:

- Cooperate with the provincial government to protect our waterworks and water sources from contamination.
- Ensure the potential risks associated with water quality are identified and assessed.
- Ensure that our water supply, treatment, storage, and distribution infrastructure is properly designed, constantly maintained, and regularly evaluated and improved.
- Include the drinking water quality and quantity priorities, needs, and expectations of our citizens, the provincial authorities, and our water system employees into our planning.
- Develop a mechanism to ensure adequate funds are available for the water utility to maintain and improve the infrastructure, implement best practices, and ensure our water treatment employees are educated about their responsibilities and adequately trained and certified.
- Establish regular verification of the quality of drinking water provided to our citizens and monitoring of the water treatment process that produce the water.
- Provide community awareness about the water supply and its management by establishing and maintaining effective reporting of the water quality and timely information about the water system to our citizens.
- Develop contingency plans and incident response capabilities in cooperation with provincial authorities.
- Where possible participate in activities to ensure continued understanding or drinking water quality issues and performance.
- Regularly assess our performance and continually improve our practices to produce good quality water.

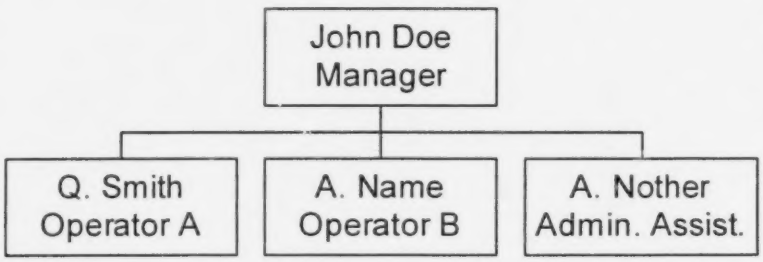
We will develop a Drinking Water Quality Management System including an implementation plan to achieve these goals and adequately manage the risks to our drinking water quality.

All of our officials, managers, and employees involved with the supply of drinking water are responsible for understanding, implementing, maintaining, and continuously improving the Drinking Water Quality Management System.

2. Organizational Structure

In this section, an organizational chart for the waterworks and associated administration should be inserted. The roles and responsibilities of each person identified in the organization structure chart should also be provided. In addition, contact information for members listed below should be included. A member of Council should be appointed as carrying the responsibility for reporting to the elected structure on the operation and condition of the works and on monthly review of records as required by section 43(2) of *The Water Regulations, 2002*.

Organization Chart



Waterworks Operations, Management and Administration

Mayor or Reeve
(Name, Address, Contact Information)
Council member responsible for waterworks
(Name, Address, Contact Information)
Municipal Administrator
(Name, Address, Contact Information)
Waterworks Manager -
(Name, Address, Contact Information)
Water Treatment Operator
(Name, Address, Contact Information)
Water Treatment Operator
(Name, Address, Contact Information)
Water Distribution System Operator
(Name, Address, Contact Information)
Wastewater Works Operator
(Name, Address, Contact Information)
Wastewater Collection System Operator
(Name, Address, Contact Information)
Others:

The following is a summary of the role and responsibility of various persons involved in production and management of drinking water for the community of _____. (Alter summary as needed and applicable – some roles may be combined and some responsibilities may be shifted in accordance with local practice or assignments).

The role of the Mayor or Reeve with respect to waterworks operation includes:

- Overall responsibility for waterworks, quality of water provided to consumers, and regulatory compliance in capacity of person responsible for the municipality or waterworks
- In conjunction with council, allocates financial resources through a budgeting process and establishes water and sewer rates and or surcharges
- Chief official in the event of a emergency situation

The role of the Council Member assigned responsibility for the Waterworks includes:

- Oversees and reports on operational, maintenance or infrastructure issues or needs to Council and the Mayor or Reeve to ensure issues are addressed
- In conjunction with the Waterworks manager reviews operational records and logs on a monthly basis in accordance with the requirements of section 43(2) of *The Water Regulations*

The role of the Municipal Administrator includes:

- Receives and prepares administrative, budget and waterworks record submissions for review of assigned Council member and to be tabled/considered at a Council meeting
- Arranges for and provides annual notification to consumers served by the waterworks on the quality of drinking water provided and on sample submission compliance. Prepares a report to Council on the state of drinking water on an annual basis
- Receives and resolves or forwards all correspondence dealing with drinking water operations from on behalf or mayor/reeve and council
- Prepares financial reports regarding waterworks operational and maintenance issues
- Prepares strategies for ensuring waterworks sustainability
- Invoicing and receipt of waterworks related expenses as well as consumer charges for water use

The role of the Waterworks Manager includes:

- Overall responsibility for the day to day operation of the waterworks
- Develops operational and maintenance protocols and plans
- Develops safety plans and conducts safety inspections
- Budget for operation and maintenance of waterworks
- Develops Waterworks Emergency Response Plan
- Provides guidance to operators on operation of works
- Staffing of waterworks operators and issues of supervision and scheduling

The role of the Water Treatment Operator(s) includes:

- Start up, shut down and periodic operating checks of plant equipment such as pumping systems, chemical feeders, auxiliary equipment (compressors), and measuring and control systems
- Makes arithmetic calculations to determine chemical feed rates, flow quantities, detention and contact times, and hydraulic loadings as required by plant operations
- Monitors the status of plant operating guidelines, such as flow pressures, chemical feeds, levels and water quality indicators, by reference to measuring systems
- Performs routine preventative maintenance, such as lubrication, operating adjustments, cleaning and painting equipment;
- Maintain plant records, including operating logs, daily diaries, chemical inventories and automated data logs
- Collects representative water samples and performs laboratory tests on samples for turbidity, chlorine residual and other tests as required by the operating permit or operational protocol
- Perform minor corrective maintenance on plant mechanical equipment, e.g.: chemical feed pumps
- Conducts tours of the waterworks and communicates with the public on issues associated with water quality
- Orders chemicals, repair parts and tools
- Load, unload and store water treatment chemicals
- Follows safety rules for plant operations

The role of the Water Distribution System Operator includes

- Periodic flushing or swabbing of the distribution system
- Locate and repair water leaks and operates, maintains and repairs valves and hydrants

- Collects and transports routine water samples from the distribution system and ensures proper packaging and shipment to the laboratory
- Performs repair work while ensuring safety procedures for the works site, traffic and the public are maintained
- Disinfects repaired or new sections of pipe and collects the necessary water samples
- Maintains distribution system plans and maps
- Cleans, disinfects and maintains reservoirs or other storage systems
- Operates and maintains any pumping equipment or facilities remote from the main water treatment plant as necessary
- Locates and eliminates cross-connections or potential cross-connections

Further information or information regarding the role of water treatment, water distribution, wastewater treatment and wastewater collection system operators, is available from "Water and Wastewater Operator Certification Program Guide, 2003, February 2003, EPB-144".

3. Operations and Maintenance Protocol

Operation of the community waterworks will be performed in accordance with design specifications and standard operating protocols of the waterworks industry. Further detail regarding standards operating procedures, range of operation and chemical feed, maintenance practices and intervals are outlined below. (Note: Persons preparing this QA/QC protocol will have to alter and complete the sections below to fit the operation of their waterworks. Due to the differing nature of waterworks across the province, by necessity, this template is general in nature.)

Waterworks Operation/Maintenance Protocol Template

System Design Capacity (m^3/day or L/s): _____

Intake – type _____
- Status of bar screens: _____
- Pump check/inspection: _____ (Frequency)
- Floating intake adjustment: _____ (Frequency)
- Depth of intake winter & summer _____
- Watershed inspection (Yes/No) _____ (Frequency)

Well(s)
- Number of wells: _____
- Pump maintenance/change-out: _____ (Frequency)
- Well/pump service disinfection: _____
- Wellhead protection inspection: _____ (Frequency)

Supply Reservoir(s)
- Inspection: _____ (Frequency)
- Algae control method: _____ (Frequency)
- Reservoir vegetation control: _____ (Frequency)
- Reservoir inspection: _____ (Frequency)
- Reservoir refill protocol (Yes/No) _____

Supply Pipeline
- Quantity supply agreement (Yes/No) _____

Pretreatment – Method

Potassium Permanganate: Dosage rate/range _____
Pre-chlorination: Dosage rate/range _____
Aeration: Rate/range _____
Other: Dosage rate/range/method _____

Coagulation & Flocculation:

Aluminum Sulfate: Dosage rate/range _____
Ferric Chloride: Dosage rate/range _____
Polymer (type): Dosage rate/range _____
Other: Dosage rate/range _____
Lime: Dosage rate/range _____
Soda Ash: Dosage rate/range _____
Mixing method: _____
Mixer inspection: _____ (Frequency)
Detention Time: _____
Jar testing: _____ (Frequency)

Sedimentation – Method _____

Turbidity measurement: _____ (Frequency)
Temperature measurement: _____ (Frequency)
Visual floc settling/distribution: _____ (Frequency)
Sludge removal – method/frequency: _____
Sludge disposal method: _____
Equipment Inspection: _____ (Frequency)

Filtration – Method/Type(s) _____

Capacity: _____
Filtration Rate: _____
Media type(s): _____
Headloss measurement: _____ (Frequency)
Backwash type (man/auto): _____
Backwash frequency: _____
Backwash rate: _____
Air assisted backwash (Yes/No) _____
Media evaluation: _____ (Frequency)
Media Replacement: _____ (Frequency)
Filter to waste (Yes/No/duration): _____
Filter Inspection: _____ (Frequency)

Iron/Manganese Control – Method/Type: _____

Filtration Rate: _____
Potassium Permanganate: Dosage rate/range _____
Pre-chlorination: Dosage rate/range _____
Aeration: Rate/range _____
Other: Dosage rate/range/method _____

Other Treatment Method(s)/Type: _____
Maintenance Type: _____
Maintenance Schedule: _____ (Frequency)
Process Waste Management _____
Inspection: _____ (Frequency)

Taste and Odour Control Method/Type: _____
Potassium Permanganate: Dosage rate/range _____
Activated Carbon: Dosage rate/range _____

Disinfection - Method/Type(s): _____
Disinfectant used: _____
Dosage rate/range: _____
Feed type: _____
Residual monitoring (location): _____ (Frequency)

Fluoridation - - Method/Type(s): _____
Chemical used: _____
Dosage rate/range: _____
Feed type: _____
Monitoring (location): _____ (Frequency)

Water Storage - Type/size: _____
Volume of treated storage: _____
Fire water capacity: _____
Output metering (Yes/No) _____
Output meter recording: _____ (Frequency)
Maintenance: _____ (Frequency)
Inspection & cleaning: _____ (Frequency)

Water Distribution System
Piping type(s): _____
Flushing schedule: _____
Foam Swabbing schedule: _____
Pumping capacity: _____ (L/s)
Emergency pumping capacity: _____ (L/s)
Backflow prevention: (Yes/No) _____
Hydrant maintenance schedule: _____
Valve maintenance schedule: _____
Repair safety procedures (Yes/No) _____
Line/Main break disinfection (Yes/No) _____
Line/Main break sampling (Yes/No) _____
Customer metering (Yes/No) _____
Truck fill station (Yes/No) _____
Truck fill backflow (Yes/No) _____
Water hauler protocols: _____

Corrosion Control – Method: _____
Chemical(s) used: _____
Cathodic protection (Yes/No) _____

4. Water Quality Monitoring, Data Collection, Record Keeping, Record Review and Reporting Procedures

The following monitoring and record keeping protocols apply to the operation of the waterworks and distribution system

Water Quality Monitoring - Permit and Regulatory Requirements

The community of _(insert community name)_ will conduct all monitoring required by permit or ministers order issued by SE. The Environmental Project Officer (EPO) _(insert EPO name)_ responsible for regulation of the waterworks will be advised of any positive bacteriological sample result as well as any exceedence of other water quality standards as determined through sampling and analysis for other substances as required by permit or ministers order. As of March 31, 2004 all required drinking water quality monitoring samples, other than samples for chlorine residual, turbidity or pH will be sent to and analyzed by an accredited laboratory. Appendix A which contains a Treated Water Quality Monitoring Plan can be used to record the communities monitoring activities and results.

The community of _(insert community name)_ will conduct daily free chlorine residual monitoring of drinking water entering the distribution system and turbidity monitoring at each filter as required by regulation, permit or ministers order issued by SE. The EPO, _(insert EPO name)_ responsible for regulation of the waterworks will be advised of any failure to meet a free-chlorine residual of at least 0.1 mg/L for water entering the distribution system as well as any exceedence of turbidity levels as required by operational permit, ministers order or regulatory requirement. Additionally, the community of _(insert community name)_ will advise the EPO, _(insert EPO name)_ responsible for regulation of the waterworks of any failure of the disinfection system or any other upset to the water treatment process, operation or distribution system concern in accordance with good practice or the emergency response plan – technical action plans for the waterworks.

Operational Monitoring Plan

Observational and measurement related operational monitoring of water quality and associated reporting requirements are established for the community of _(insert community name)_ waterworks. Water works operators will monitor operational process in accordance with Table 1. (Note: Monitoring requirements should be established for all aspects of the water supply system where possible and Table 1 offers guidance for this task – certain monitoring may not apply to specific systems and the table should be modified accordingly. SE's EPOs may be consulted with respect to selection of operational process monitoring appropriate to a specific waterworks).

Table 1. Operational parameters – Examples

Operational Parameter	Treatment step/Process					
	Raw water	Coagulation	Sedimentation	Filtration	Disinfection	Distribution system
pH	☑	☑	☑		☑	☑
Turbidity (or particle count)	☑	☑	☑	X	☑	☑
Temperature	☑		☑		☑	☑
Dissolved Oxygen	☑					
River/stream flow	☑					
Total coliforms	☑				☑	X
Background bacteria					☑	X
Colour	☑				☑	
Conductivity	☑					
Alkalinity	☑	☑	☑			
Organic carbon	☑		☑		☑	
Algae and algal toxins	☑					☑
Chemical dosage		☑			☑	
Flow rate		☑	☑	☑	☑	
Headloss					☑	
CT					☑	
Disinfectant residual					X	X
Disinfection By Products					☑	X
Presssure						☑

Key: Items with a check mark are recommended
Items with an "X" are mandatory

Record Keeping

Waterworks records and logs will be kept in accordance with the requirements of The Water Regulations, 2002. The following persons are delegated responsibility for operational record and log keeping: (insert name(s) of persons appointed by Mayor and Council to keep waterworks records and logs). perational records and logs will include:

- total water pumped into the distribution system on a daily basis or the total raw water used;
- the types, dosages and total amounts of chemicals applied to the water for treatment;
- locations from which samples for any tests conducted by the permittee of the waterworks were taken in accordance with the permittee's permit and the name of the person who conducted the sampling or testing and the results of those tests;
- any departures from normal operating procedures that may have occurred and the time and date that they occurred;

- any instructions that were given during operation of the waterworks to depart from normal operating practices and the name of the person who gave the instructions;
- any upset condition or bypass condition, the time and date of the upset condition or bypass condition and measures taken to notify others and resolve the upset condition or bypass condition;
- any condition of low disinfectant levels, the time, date and location of occurrence and measures taken to restore disinfectant levels to required values;
- the dates and results of calibrating any metering equipment and testing instruments; and
- the dates and types of maintenance performed on equipment and any actions taken to ensure the normal operations of the waterworks.

The operational records or logs mentioned above will be recorded and maintained in the following manner:

- operational records or logs must be made in chronological order, with the dates, times and testing locations clearly indicated;
- entries in an operational record or log will only be made by the permittee or person specifically appointed by the permittee;
- persons making an entry in an operational record or log shall do so in a manner that allows the person to be unambiguously identified as the maker of the entry;
- operational records or logs must be maintained for at least five years;
- any anomalies or instances of missing entries in an operational record or log must be accompanied by explanatory notes;
- operational records or logs must only contain data or information that is actually observed or produced;
- operational records or logs must not contain default values generated manually or by automated means;
- operational records or logs maintained in accordance with the above requirements must be made available promptly on request of the Minister of Environment or a representative of the Minister.

(Note: Sample waterworks log and record sheets are provided by SE in the Drinking Water Information Binder which may be used and modified as necessary to aid in record/log keeping at waterworks (see tab 11 in binder provided by to each waterworks)).

Record Review and Reporting

The assigned council member and the waterworks manager will review all monitoring results, records and operational logs on a monthly basis. If the review of the records or logs indicates that the quality of water from the waterworks has been adversely affected, the findings will be reported to SE as soon as reasonably practical after the report has been completed.

5. Emergency Response Planning

Guidance for Emergency Response planning is available from SE in the form of detailed information (Guidelines for Waterworks Emergency Response Planning, EPB-240) and as a template for community waterworks emergency response, "Waterworks Emergency Response Planning Template, EPB-241". These documents provide guidance on Emergency contact listings, establishing a waterworks emergency planning taskforce, crisis management, notification and communication as well as technical action plans for a number of incidents which commonly occur.

APPENDIX – A

TREATED WATER QUALITY MONITORING PLAN

Parameters (list as specified in the permit)	Sampling location	Sampling method	Results	SE standards/ guidelines	Compliance with standards/ guidelines	Remarks
Bacteriological						
1. ----------	----------	----------	----------	----------	----------	----------
2. ----------	----------	----------	----------	----------	----------	----------
Chemical						
1. ----------	----------	----------	----------	----------	----------	----------
2. ----------	----------	----------	----------	----------	----------	----------
3. ----------	----------	----------	----------	----------	----------	----------
4. ----------	----------	----------	----------	----------	----------	----------
5. ----------	----------	----------	----------	----------	----------	----------
6. ----------	----------	----------	----------	----------	----------	----------
7. ----------	----------	----------	----------	----------	----------	----------
8. ----------	----------	----------	----------	----------	----------	----------
9. ----------	----------	----------	----------	----------	----------	----------
10. ----------	----------	----------	----------	----------	----------	----------
11. ----------	----------	----------	----------	----------	----------	----------
12. ----------	----------	----------	----------	----------	----------	----------
Chemical-Health category						
1. ----------	----------	----------	----------	----------	----------	----------
2. ----------	----------	----------	----------	----------	----------	----------
3. ----------	----------	----------	----------	----------	----------	----------
4. ----------	----------	----------	----------	----------	----------	----------
Physical						
1. pH	----------	----------	----------	----------	----------	----------
2. Temperature	----------	----------	----------	----------	----------	----------
3. ----------	----------	----------	----------	----------	----------	----------
4. ----------	----------	----------	----------	----------	----------	----------
5. ----------	----------	----------	----------	----------	----------	----------
Other						
1. Turbidity	----------	----------	----------	----------	----------	----------
2. Residual Disinfectant Concentration	----------	----------	----------	----------	----------	----------